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Water Current

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GUEST EDITORIAL

by

Hal L. Schroeder, Chairman
Water Resources Research Institute Advisory Committee

The opportunity offered by Dr. Viessman to utilize this space for some personal observations is very much appreciated. In reviewing the past few issues of this page of "Water Current", I noted, in the May issue, speaking of the need for research in advance of crisis situations, Dr. Viessman commented "Once the well has gone dry, there is no need for study." In the June issue is a listing of ten major study areas of research needs. It is interesting that the problem of research regarding drouth was not listed as one of the ten study areas.

The people of Nebraska, and of surrounding states, are now painfully aware of the words of Benjamin Franklin: "When the well's dry, we know the worth of water." Although many wells have gone dry, and many fields will produce no crops because of the lack of rainfall, the fact that there is much evidence that drouth is a cyclic occurrence (perhaps having a twenty-year interval) provides the opportunity for research, and answers, before the next such period occurs.

Answers to many questions might be provided through the research activities of Water Resources Research Institutes and similar agencies. Are periods of extreme sub-normal rainfall indeed cyclic, and can they be predicted? Obviously, advance warning of perhaps a year would in itself solve many problems. Additional research is needed in drouth resistant crop varieties and on farming practices to be utilized in dry years. Research needs to be continued on methods of storing surplus water during wet years, either in surface or in sub-surface reservoirs, for use in dry years.

We should not forget that past dry years were a stimulus to research and to the adoption of practices which have reduced the impact of the current crisis. Extensive use of irrigation is an example. The"dirty thirties" of forty years ago were the basis for the formation of the Soil Conservation Service and resulting soil and water conservation measures, including tree shelter belts, new grass species, and the formation of soil conservation districts, now evolved into Natural Resources Districts in Nebraska.

Even while we are coping with the current drouth, we should be initiating research in water management to lessen the impact of the next drouth.

ON THE HOMEFRONT

DEADLINES FOR RESEARCH PROPOSALS

Deadlines for filing research proposals for fiscal year 1976 with the Water Resources Research Institute have been established. Matching grant proposals must be received not later than September 15, 1974 and annual allotment proposals not later than December 15, 1974.

Prospective principal investigators should make an appointment to discuss their proposals with the Institute Director before they begin writing.

For further information, contact: Dr. Warren Viessman, Jr., Director, Water Resources Research Institute, 212 Ag. Engineering Building, University of Nebraska, Lincoln, Nebraska 68503. Telephone 472-3307.

RESEARCH CONTRACTS FROM OLD WEST COMMISSION

The Water Resources Research Institute has secured two research contracts from the Old West Regional Commission. One project is entitled "Energy Reduction Through Improved Irrigation Practices" with Dr. W. E. Splinter, Chairman of Ag. Engineering Department, as principal investigator. The objective is to reduce by 50 percent the energy required for irrigation by sprinkler and gravity systems.

The other research project is entitled "Water Quality Study of Runoff From Agricultural Lands," and the principal investigator is Dr. Dewey R. Andersen, Department of Civil Engineering. The objectives are to determine the quantity and quality of runoff from agriculturally oriented drainage basins and to evaluate and develop modeling programs for simulating runoff from agricultural areas. Data obtained will provide valuable insight into the effect of cropping practices on soil and nutrient loss.

The Old West Regional Commission was established in August 1972 under the Public Works and Economic Development Act of 1965. It is one of seven multi-state regional economic development commissions throughout the country, each seeking to ally the federal government with state and local governments in formulating a comprehensive and coordinated action for regional economic development. The Old West Regional Commission includes five states--Montana, North Dakota, South Dakota, Wyoming and Nebraska. It is composed of both federal and state members. The state members are the governors of the five Old West states. To achieve Commission approval, an action or proposal must be accepted by the Federal Cochairman and a majority of the state members. The Federal Cochairman and his staff are located in Washington, D.C., and the Commission headquarters under an Executive Director is located in Rapid City, South Dakota.

STATE RECLAMATION PROJECTS FUNDED

The Public Works Appropriations Bill recently passed by the House of Representatives includes $1,499,000 for reclamation projects in Nebraska. Rep. Dave Martin said the fiscal 1975 appropriations bill includes $500,000 for the North Loup Project, $550,000 for the O'Neill Project and $449,000 for the Nebraska Mid-State Project. The funds are for advance planning work.

Located in central Nebraska, the North Loup Project would irrigate 53,000 acres in Valley, Greeley, Howard and Nance Counties. Proposed facilities for the project would include dams and reservoirs on the Calamus River and Davis Creek, tributaries of the North Loup River, 158 miles of canals and 212 miles of laterals.

The O'Neill Project would irrigate 77,000 acres in Keya Paha and Holt Counties. Project facilities would include a dam and reservoir at Norden and a distribution system of 362 miles of canals and laterals.

The Nebraska Mid-State Project, located along the Platte River in central Nebraska, would irrigate 140,000 acres and is currently processing sign-up of acreage.

WATER MANAGEMENT NEEDED IN NEBRASKA

According to testimony before the Unicameral's Public Works Committee, Nebraska can double the number of acres under irrigation but needs an overall system of water resources management.

Dr. Duane Acker, Head of the Institute for Agriculture and Natural Resources, said about 5 million acres in Nebraska are irrigated and an estimated 9 million acres will be irrigated by 2020. Sixteen to 20 million acres are amenable to irrigation.

Vince Dreeszen, Director of the Conservation & Survey Division, said there may not be sufficient water available annually to irrigate 16 million acres. He also said ground and surface water reservoirs must be incorporated into a management system. Primary problems include upgrading and expansion of surface water storage and recharge of groundwater supplies. Surface water storage expansion would decrease the flow in streams and rivers out of Nebraska and into Kansas and Missouri. Storage could be attained during years of plentiful stream and river water runoff.

In groundwater, Dreeszen recommended "firming-up" registration laws to oversee irrigation wells rather than an all-out permit system. He favors "local option with state guidelines" in regulating wells and groundwater recharge. Restrictive control is needed over groundwater usage in problem areas where the supplies are easily depleted.

The committee's investigation stems from a resolution by Senator Maurice Kremer which directs the committee to study laws relating to underground and surface water and recommend new legislation to deal with these problems.

DEC ISSUES POWER PLANT PERMIT

The Department of Environmental Control (DEC) has issued a permit to NPPD to build a coal-burning power plant in western Nebraska. The Sierra Club has challenged these plans with the contention that there is no proof the plant will not violate clean air regulations.

At recent hearings on the NPPD plant, the Colorado Public Service Company's Commanche Power Plant in Pueblo, Colorado was discussed. This power plant is nearly identical in equipment (although smaller in generating capacity) to the Gerald Gentleman Station power plant which NPPD wants to build near Sutherland. The Colorado plant burns coal mined from the same seam in the Powder River Basin in Wyoming where coal will be mined for burning in Gentleman Station. Colorado Air Pollution Commission enforcement officials have said the Commanche plant meets Colorado regulations for density of smoke, emission of particulates (fly ash and dust) and emission of sulfur dioxode.

In granting NPPD permits to build the power plant near Sutherland, DEC laid down two conditions that must be met: (1) Equipment must be installed to measure density of smoke. NPPD is required by law to do this anyway and had verbally expressed its intent to comply with the law. (2) A system must be established to measure sulfur content of coal shipped to the plant and measuring results must be sent to NPPD and DEC before the coal is shipped to the plant. This would eliminate the possibility of high-sulfur coal being sent to the plant.

Despite these conditions, Sierra Club attorney H. Anthony Ruckel has promised that the Sierra Club will take the matter to court in an attempt to force NPPD to install "scrubbers" at Gentleman Station to reduce sulfur dioxide emissions.

RANN PROPOSAL GUIDELINES AVAILABLE

The Nebraska Water Resources Research Institute has recently received a copy of "Guidelines for Preparation of Unsolicited Proposals to the Program of Research Applied to National Needs (RANN)." The RANN program is a division of the National Science Foundation and sponsors research in the following areas:

-- Energy Research and Technology

-- Advanced Technology Applications

-- Environmental Systems and Resources

-- Social Systems and Human Resources

-- Exploratory Research and Problem Assessment

Anyone desiring further information on the RANN program or a copy of the Guidelines should contact: Dr. Warren Viessman, Jr., Director, Water Resources Research Institute, 212 Ag. Engineering Building, University of Nebraska, Lincoln, Nebraska 68503. Telephone (402) 472-3307 or 3305.

FEDERAL HIGHLIGHTS

WATER RESOURCES INFORMATION PROGRAM

The University of Wisconsin-Madison announces the availability of its Water Resources Information Program. This program will perform computerized literature searches for persons in any profession who have questions in the area of water resources. The UW computer terminal is one of four water resources information retrieval centers in a national computer network sponsored by OWRR/WRSIC. The program will serve the water-related information needs of persons in a 14-state region including Nebraska.

Several developments have made faster, more comprehensive literature searches possible. First, the WRSIC data base has been moved from the University of Oklahoma to the Oak Ridge National Laboratory in Tennessee and has grown to more than 70,000 abstracts. Second, the WRSIC network uses a remote terminal cathode ray display, allowing faster responses and now has access to the data base for 50 hours every week. Finally, in addition to the national water resources data base, it is possible to search eight other data bases for information. These include Nuclear Science Abstracts, Energy Data Base, Toxic Materials Data Base, Energy R & D Projects, Mercury Data Base, Heated Effluent Bibliography, Power Reactor Dockets, and Coal Gasification Research.

The Nebraska Water Resources Research Institute will be receiving literature search request forms which may be used by anyone wishing to send in an information request. The inquiry form can be mailed to the University of Wisconsin or may be phoned in. The average search usually takes less than one-half hour, and responses to requests in computer printout form should be available within 5 to 7 days. The cost is $1.00 per connect minute plus first class postage for mailing the printout.

For further information contact Dr. Warren Viessman, Jr., Director, Nebraska Water Resources Research Institute, 212 Ag. Engineering Building, University of Nebraska, Lincoln, Nebraska; or LeRoy G. Zwiefel, Director, Water Resources Information Program, University of Wisconsin-Madison, 1513 University Avenue, Madison, Wisconsin 53706. Telephone (608) 262-7980.

PRINCIPLES AND STANDARDS - PROCEDURE #1

A new Procedure for applying the Water Resources Council's Principles and Standards to water resources project plans (Level C) which were substantially completed or pending approval prior to the effective date of the Principles and Standards has been announced by Warren D. Fairchild, Director of the Council.

Mr. Fairchild, in announcing the new Procedure, said: "The Principles and Standards will make a significant change in the project formulation and evaluation processes followed by the agencies in planning programs and projects for the management of water and related land resources. Each of the Council's participating agencies has a number of plans on which all field studies have been completed, and the proposals are in the final stages of clearance and processing. These reports represent hundreds of thousands of man-hours of planning

effort, including both Federal and non-Federal inputs, and millions of dollars of planning funds. A rigid application of the Principles and Standards would greatly increase the planning costs, cause prolonged delays in completion of the plans, and negate a significant portion of the planning effort and funds expended."

Procedure #1 is an evolutionary approach to systematically applying the Principles and Standards to implementation studies in process.

Copies of Procedure #1, "Schedule and Application of Principles and Standards to Implementation Studies in Process," and the Principles and Standards, are available upon request.

NEW ENERGY DEVELOPMENTS WILL USE MORE WATER

The Nation's expanding energy development will demand larger quantities of water than ever before, particularly for generating electrical power, according to a new U.S. Geological Survey, Department of the Interior report.

Although cooling thermal-electric power plants will continue to be the greatest withdrawal use of water (more than 170 billion gallons per day at the present time), new energy-producing processes, such as coal gasification and liquefaction, oil shale production, nuclear fuel processing, and water flooding methods of oil retrieval, will also require large amounts of water.

The report provides broad estimates of the amounts of water that will be needed for production of energy from typical units, plants, sites for mining, reclamation of mined lands, onsite processing, transportation, refining, and conversion of fuels to other forms of energy.

Some of the report's findings include the following:

(1) In 1970, about 170 billion gallons of water per day were withdrawn for thermal-electric power plant cooling. Even larger water withdrawals will be needed in the future to meet growing demands for power.

(2) Coal-mining water demands are modest, and include water for dust control, fire protection, and coal washing. Also, in areas of low precipitation, an additional water demand exists for establishing vegetation on disturbed areas following surface mining.

(3) Oil and gas extraction generally involves only nominal water demands for drilling; about 12 billion gallons of fresh water annually nationwide. Where water flooding is employed as secondary recovery technique, however, somewhat larger quantities are needed to drive oil toward recovery wells.

(4) Uranium mining involves water demands for dust control, ore beneficiation, and revegetation similar to coal mining, but tonnage handled is much less than for coal; thus, the total water requirements are lower.

(5) Oil-shale mining will eventually consume large volumes of water, especially for compaction and revegetation of waste materials produced by processing the shale. Current estimates suggest that 2.5 to 4 volumes of water will be consumed per volume of oil produced.

(6) The only significant potential use of water for energy transport, aside from in-stream navigation use, is for the transport of coal in pipelines as a slurry.

(7) Atomic Energy Commission figures indicate that production of the fuel for a typical 1,000-mw light-water reactor steam-electric plant operating 80 percent of the time consumes about 163 million gallons of water per year. Of this total consumption, about 40 percent is used in the uranium-ore milling stage, almost entirely as evaporation from tailing ponds. Another 55 percent is used for evaporative cooling in the uranium enrichment plant and the remainder of the water is used for production of uranium hexafluoride and reprocessing of used fuel elements.

(8) Water demand for petroleum refining is highly variable, depending upon such factors as process employed, refinery design, and cost and availability of water. Water demand is estimated at 39 gallons per barrel of crude-oil input, or roughly 1 volume of water consumed per 1 volume of crude. Of this consumption, 71 percent was accounted for in evaporative cooling, 26 percent as boiler feed water, and the remaining 3 percent for sanitary and other in-plant uses.

(9) Estimates of the most likely amounts of water consumed by an oil-shale mine, retort, and upgrading plant of 100,000 barrels per day capacity range from about 7,500 gallons per minute to 11,400 gallons per minute.

(10) Water consumption in coal gasification plants of 250 million standard cubic feet (scf) per day capacity of pipeline quality gas can be expected to range from about 3 billion gallons per year where water is at a premium, to 15 billion gallons per year where abundant but poor quality water is used for cooling.

(11) Estimation of water consumption in producing oil from coal is tenuous at best because no commercial-scale operations exist in the United States, and none of several possible processes has been shown to be competitive with alternate fuels. The National Petroleum Council has adopted a figure of about 65,000 gallons of water consumed per year for each barrel per day of oil produced at coal liquefaction facilities. This translates into about 6.5 billion gallons of water consumed each year for 100,000 barrels of oil produced each day.

The report "Water Demands for Expanding Energy Development," by George H. Davis and Leonard A. Wood, and published as USGS Circular 703, is available free upon request to the Director, U.S. Geological Survey, Reston, VA, 22092.

CONFERENCES

GROUNDWATER QUALITY SYMPOSIUM

The USEPA and the National Water Well Association are sponsoring the second national Groundwater Symposium September 25-27, 1974 in Denver, Colorado. The purpose of this conference on groundwater protection technology is "to bring together a nucleus of men, methods and ideas capable of yielding solutions to problems which must be solved to ensure the protection and restoration of the quality of our vast groundwater resources, development of which is destined to double and perhaps triple in the coming decade."

The Symposium will focus on four primary problem areas: (1) the impact of zero discharge legislation on groundwater; (2) lesser-known groundwater pollution hazards; (3) operation and maintenance of domestic waste disposal systems discharging into groundwater; and (4) new technology for groundwater protection.

For additional information, write Second National Groundwater Quality Symposium, c/o NWWA, Suite 1350, 88 East Broad Street, Columbus, Ohio 43215.

CONCEPTS OF GROUNDWATER MANAGEMENT

The Department of Water Science and Engineering of the University of California, Davis, and the University of California Water Resources Center are co-sponsoring "Concepts of Groundwater Management," scheduled for six full-day sessions October 31, November 1 and 2 and November 14, 15, and 16, 1974, on the Davis campus of the University of California.

This course is designed for technical and management personnel of consulting firms, water districts, local, state and federal agencies and others who are interested in groundwater utilization and management. It will cover the fundamentals of groundwater including technical principles and emerging concepts of management. Instruction will be by individuals active in groundwater in the California Department of Water Resources, water districts, and water well contracting, as well as by University faculty and staff specialists.

The course will deal primarily with groundwater in California with emphasis on: the geology and occurrence of groundwater, including basic concepts, technical terms, methods of exploration; groundwater hydrology, including determination of aquifer characteristics by direct and indirect methods, and groundwater movement; water well design, construction, and development; groundwater quality; and groundwater management, including models of groundwater systems, artificial recharge, sea water intrusion, land subsidence, and the legal, economic, and institutional aspects of conjunctive use of groundwater with surface water supplies.

For further information, write Joe Scalmanini, Department of Water Science and Engineering, University of California, Davis, California 95616, or phone (916) 752-0453.

RESEARCH REVIEW

PROJECT TITLE: "A Regional Model for Predicting Great Plains Evapotranspiration"

PRINCIPAL INVESTIGATOR: Norman A. Rosenberg, Professor
Dept. of Horticulture & Forestry

The prime objective of the research project is to test the utility of a resistance model for estimating evapotranspiration rates over large areas. Aside from some easily obtained meteorological data, the model requires information on ground or crop temperature and on boundary layer resistance. Therefore, subsidiary objectives are: (1) to determine the feasibility of obtaining ground and crop temperature data by remote sensing with infrared thermometry and the accuracy achievable by these means; and (2) to quantify the boundary layer resistance to diffusion as a function of crop height, crop roughness and wind speed.

This project is being performed in cooperation with the Kansas Water Research Institute, Evapotranspiration Laboratory. Since the project's inception, the Nebraska and Kansas participants have been in close contact in order to coordinate scheduling of experimental work, methodology and instrumentation.

Aircraft flight runs are shceduled for late July and mid-late August over Mead, Nebraska and Manhattan, Kansas. Flights will be made three times on the day of each run at two altitudes each time. During one run (probably the later one) a day of observation will be scheduled at the Scottsbluff station as well as at Mead and Manhattan. Preparations are now underway at all three stations to establish vigorous crop cover. Instrumentation is being assembled to gather all meteorological data needed for application of the resistance model. Lysimeters are being activated to provide an absolute measure of water use synchronous with the remote sensing flights.

Accurate estimates of evapotranspiration (ET) over large areas are valuable for hydrologic studies, irrigation planning and scheduling and other practices related to efficient utilization of water resources. Rates of ET have been measured in a number of agronomic and micrometeorological studies conducted in recent years in the Great Plains and Missouri River Basin region. These have been made largely in small fields where soil moisture stress is usually kept low so that potential ET is measured. A method is needed to extrapolate the results of this intensive experimentation to large areas where cropping patterns differ from field to field and season to season and where soil moisture availability varies greatly during the course of a growing season. Traditional methods used by geographers to classify climates and by hydrologists and engineers for developing water distribution schemes do not provide the necessary sensitivity to accurately estimate ET under varying conditions and are not easily applied to large regions.

A model which provides accurate ET values from readily available meteorological inputs is sorely needed. The ET model proposed in this project for testing and development may hold promise of satisfying this need. The model

is mathematically simple. The number of measurements required for its use is small and much of the required data can be obtained from the National Weather Service sources. The model requires knowledge of boundary layer resistance and of crop temperature. The latter can be achieved through existing remote sensing technology. Such a research program lends itself to a regional project where interstate boundaries disappear and raw research data are put together to be interpreted by a regional research group.

The proposed model should be sufficiently sensitive so that daily estimates of ET over large regions can be derived--eventually on a routine basis--for reporting to irrigators and water distribution agencies. The model, if found reliable, may be easily included as a subcomponent of more complex stochastic models of large hydrologic systems.

PUBLICATIONS RECEIVED BY THE INSTITUTE

NWRRI LIBRARY

1. The Financial Feasibility of the Regional Approach to Public Water Supply: A Case Study of Northwest Arkansas, Norman C. Williams and J. Martin Redfern, Agricultural Experiment Station, Division of Agriculture, University of Arkansas, Fayetteville, Arkansas, June 1974.

2. Reflectorized Soybeans: Growth, Production and Longwave Radiation Balance, Maximo W. Baradas, Agricultural Experiment Station, Institute of Agriculture and Natural Resources, University of Nebraska, Lincoln, Nebraska, June 30, 1974.

3. Aquatic Fungi in Rivers: Their Distribution and Response to Pollutants, David F. Farr, Robert A. Paterson, Virginia Water Resources Research Center, Blacksburg, Virginia 24061.

4. Biology, Distribution, Importance and Control of Deer Flies and Horse Flies (Diptera:Tabanidae) in Water-Oriented Recreational Areas, T. R. Adkins, Jr., Water Resources Research Institute, Clemson University, Clemson, South Carolina, April 1974.

5. Economic Analysis of Water Supply Needs and Alternatives in a Multi-County Industrial Area, Gaines H. Liner, James M. Stepp, Water Resources Research Institute, Clemson University, Clemson, South Carolina, April 1974.

6. Earth Resources Program (8 books), Earth Observations Division, Science and Applications Directorate, National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Texas, August - November and December, 1973.

7. Agricultural Waste Water Accommodation and Utilization by Various Forages, Viggo Larsen, John H. Axley, Gary L. Miller, University of Maryland, Water Resources Research Center, College Park, Maryland.

8. The President's 1973 Environmental Program, Compiled by the Council on Environmental Quality, April 1973.

9. Community Adoption of Water Reuse Systems in the United States, Roger E. Kasperson, Duane Gaumann, Daniel Dworkin, David McCauley, John Reynolds, and John Sims, Worcester, Massachusetts, 1974.

10. Water Demands for Expanding Energy Development, George H. Davis, Leonard A. Wood, U.S. Geological Survey, National Center, Reston, VA.

11. Predicted Water-Level Declines for Alternative Groundwater Developments in the Upper Big Blue River Basin, Nebraska, Peter W. Huntoon, Conservation and Survery Division, Institute of Agriculture and Natural Resources, University of Nebraska, Lincoln, Nebraska.

12. Management and Administration of Groundwater in Interstate Aquifers - Phase II, M. W. Bittinger, E. Bruce Jones, Ward H. Fischer, M. W. Bittinger and Associates, Inc., P.O. Box Q, Fort Collins, Colorado, June 1974.

13. Water Resource Problems and Research Needs of North Carolina - A Reassessment, David H. Howells, Director, Water Resources Research Institute of the University of North Carolina, 124 Riddick Building, North Carolina State University, Raleigh, North Carolina, June 1, 1974.

14. Management of Urban Storm Runoff, Water Resources Engineers and The Hydrologic Engineering Center, Corps of Engineers, American Society of Civil Engineers, 345 East 47th Street, New York, New York, May 1974.

15. A Model for Evaluating Runoff-Quality in Metropolitan Master Planning, L. A. Roesner, H. M. Nichandros, R. P. Shubinski, A. D. Feldman, J. W. Abbott, A. O. Friedland, American Society of Civil Engineers, 345 East 47th Street, New York, New York, April 1974.

16. A Review of the Physiological Impact of Mercurials, M. Catherine Ferens, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., February 1974.

17. Groundwater Geology of Southwest Nebraska Ground Water Conservation District, Guy J. Leonard and Peter W. Huntoon, Institute of Agriculture and Natural Resources, University of Nebraska - Lincoln, May 1974.

18. Practices in Detention of Urban Stormwater Runoff, Herbert G. Poertner, American Public Works Association, 1313 East 60th Street, Chicago, Illinois, 1974.

19. Annual Report - The Central Nebraska Public Power and Irrigation District, P.O. Box 356, Holdrege, Nebraska, 1973.

C. Y. THOMPSON LIBRARY

1. Investigation of the Chemical Identity of Soluble Organophosphorus Compounds Found in Natural Waters, Roger A. Minear, Kenneth A. Walanski, University of Illinois, Water Resources Center, 2535 Hydrosystems Laboratory, Urbana, Illinois, May 1974.

2. Large-Scale Mass Balance for Lead in Southern Lake Michigan, Allen C. Cogley, University of Illinois, Water Resources Center, 2535 Hydrosystems Laboratory, Urbana, Illinois, May 1974.

3. Determination of Investment Cost Functions of Water Treatment Plants, Hirohide Hinomoto, University of Illinois, Water Resources Center, 2535 Hydrosystems Laboratory, Urbana, Illinois, May 1974.

4. Financing Pollution Abatement Equipment for Textiles and Other South Carolina Industries, Department of Economics, College of Industrial Management and Textile Science, Clemson, South Carolina, March 26, 1974.

5. Water Resources Problems and Research Needs in Minnesota, 1974 - Guidelines for Research Programs, William C. Walton, Water Resources Research Center, University of Minnesota, Graduate School, Minneapolis, Minnesota, June 1974.

6. The Role of Organic Debris and Associated Micro-Organisms in Pelagic Estuarine Food Chains, Donald R. Heinle, David A. Flemer, Joseph F. Ustach, Richard A. Murtagh, Roger P. Harris, University of Maryland, Water Resources Research Center, College Park, Maryland.

7. Water Resources Planning for the Houston-Galveston Region, A Seminar held at the University of Houston, Department of Civil Engineering, Houston, Texas, January 18, 1971.

8. Quality of Surface Waters of the United States, 1968 (Parts 12-16. North Pacific Slope Basins, Alaska, Hawaii, and other Pacific Areas), U.S. Government Printing Office, Washington, D.C.

9. A Case Study in Interstate Resource Management: The California-Nevada Water Controversy, 1955 - 1968, W. Turrentine Jackson, Donald J. Pisani, California Water Resources Center, University of California, David, CA, May 1974.

10. Improvement of Trout Streams in Wisconsin by Augmenting Low Flows with Groundwater, R. P. Novitzki, Geological Survey Water-Supply Paper, United States Government Printing Office, Washington, D.C. 20402.

11. An Ion-Exchange Process for Recovery of Chromate from Pigment Manufacturing, Donald J. Robinson, Harold E. Weisberg, Glenn I. Chase, Kenneth R. Libby, Jr., James L. Capper, National Environmental Research Center, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio, June 1974.

12. Renovation of Secondary Effluent for Reuse as a Water Resource, Louis T. Kardos, William E. Sopper, Earl A. Myers, Richard R. Parizek, John B. Nesbitt, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., February 1974.

13. Sources of Oil and Water in Bilges of Great Lakes Ships, John B. Woodward, National Environmental Research Center, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio, July 1974.

14. Quality of Surface Waters of the United States, 1968 - Part 7, Lower Mississippi River Basin, Geological Survey Water-Supply Paper, Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.

15. Optimization and Design of an Oil Activated Sludge Concentration Process, T. M. Rosenblatt, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., February 1974.

16. Turbulent Diffusion in Liquid Jets: Part I, Charles H. Tinsley, Warren S. Stevenson, Victor W. Goldschmidt, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., March 1974.

17. Development of Sample Preparation Methods for Analysis of Marine Organisms, Herbert C. McKee, David S. Tarazi, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., January 1974.

18. The Swirl Concentrator as a Grit Separator Device, Richard H. Sullivan, Morris M. Cohn, James E. Ure, Fred Parkinson, National Environmental Research Center, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio, June 1974.

19. The Market Structure of the Southern California Water Industry, Larry D. Schelhorse, Peggy Zimmerman, Dr. Jerome W. Milliman, Dr. David L. Shapiro, Dr. Louis F. Weschler, Copley International Corporation, 7817 Herschel Avenue, P.O. Box 1530, La Jolla, California, June 1974.

20. New Microbial Indicators of Wastewater Chlorination Efficiency, Richard S. Engelbrecht, David H. Foster, Elaine O. Greening, Sai H. Lee, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., February 1974.

21. Water Percolation in the Oceanic Crust Conference on Magnetospheric - Ionospheric Coupling 1974 Special Assemblies of IAMAP-IAPSO, Transactions, American Geophysical Union, Vol. 55, No. 8, August 1974.

QUESTIONS AND INQUIRIES

Newsletter items and inquiries should be sent to: Jeanne Enevoldsen, Editor, Nebraska Water Resources Research Institute, 212 Ag. Engineering Building, University of Nebraska - East Campus, Lincoln, Nebraska 68503; or phone (402) 472-3307.